54. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Information Technology and Electrical Engineering - Devices and Systems, Materials and Technologies for the Future

Faculty of Electrical Engineering and Information Technology

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=14089

TECHNISCHE UNIVERSITÄT
ILMENAU

Impressum

Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c.
Peter Scharff

Redaktion: Referat Marketing
Andrea Schneider

Fakultät für Elektrotechnik und Informationstechnik
Univ.-Prof. Dr.-Ing. Frank Berger

Redaktionsschluss: 17. August 2009

Technische Realisierung (USB-Flash-Ausgabe):
Institut für Medientechnik an der TU Ilmenau
Dipl.-Ing. Christian Weigel
Dipl.-Ing. Helge Drumm

Technische Realisierung (Online-Ausgabe):
Universitätsbibliothek Ilmenau
ilmedia
Postfach 10 05 65
98684 Ilmenau

Verlag:
Verlag ISLE, Betriebsstätte des ISLE e.V.
Werner-von-Siemens-Str. 16
98693 Ilmenau

ISBN (USB-Flash-Ausgabe): 978-3-938843-45-1
ISBN (Druckausgabe der Kurzfassungen): 978-3-938843-44-4

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=14089

EQUIVALENT SCHEME OF THE DEVICE WITH THE CHANGE LINK GUIDED BY THE P-N-JUNCTION

Nikolai Tsyrelchuk, Elena Ruchaevskaia

INTRODUCTION

For the modeling the schemes with the metal dielectric semiconductor (MDS) devices with the charge link (DCL) usually the structure, consisting of a number of MDS-elements, separated by the gates, is considered. By analogy with this the devices with the charge link, guided by p-n junctions (DCLGJ), can be considered as a number of p-n-p (or n-p-n) vertical elements, separated by the gates. That's why for modeling the schemes on DCLGJ the model DCL itself and the gap model can be used.

MICR0- AND NANOELECTRONICS

We propose the simple electric DCLGJ model, where the interpretation of the transfer equations in the semiconductor with the help of the circuit equation was taken as a principle [1]. The structure fragment and the equivalent scheme of one element of DCLGJ are depicted in (see Fig. 1). Where 1– gate region; 2 – channel region; 3 – base

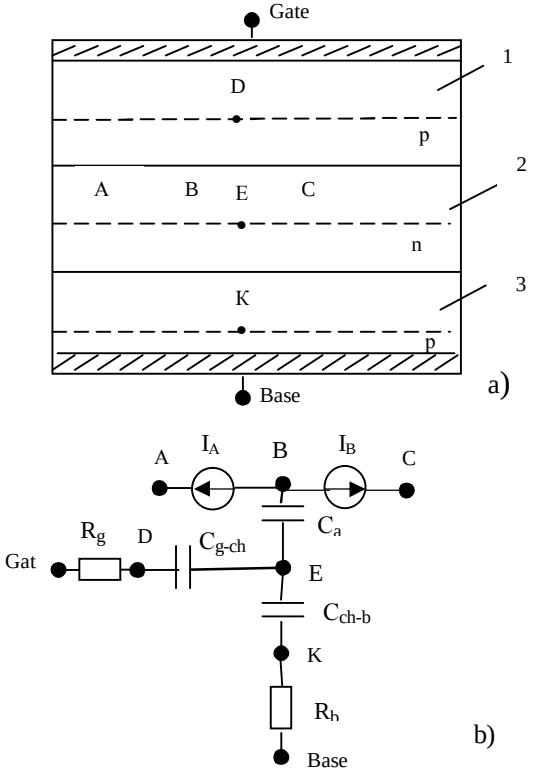

Figure 1 The structure fragment a) and equivalent scheme b) DCLGL element

On the equivalent scheme (Fig.1) $C_{g\text{-}ch}$ и $C_{c\text{-}bh}$ capacities correspond the capacities of the backward biased p-n junctions gate-channel and channel-base, accordingly. C_a – accumulation (storage) capacity of the electrons. R_b и R_g – ohmic resistances of the base and gate, accordingly, I_A and I_B – the current sources, taking into account the channel conductivity [1].

The points и A, B, C are three different points in the DCL channel, the voltage in which equals the value of the electron potential of the Fermi quasilevel F_p. The points D, K define the boundaries of the depleted layers in the gate regions and the base, accordingly. The voltage in the point E equals electrostatistical potential F_{ch} in this point, i.e. the potential channel. Capacities $C_{g\text{-}ch}$ и $C_{ch\text{-}b}$ are calculated by the formulae for the reverse drifted p-n junctions considering them to be a step-like.

The charge in the channel is accumulated on the condenser Ca. This condenser is charged and discharged by the IA and IB currents. Other possible mechanisms of charging and discharging of the Ca capacity, such as the thermal generation in the depleted layer, leakage. The value Ca capacity is calculated according to the expression:

$$C_a = \left(\frac{e_o e_n q n_i}{2 j_T} \right)^{\frac{1}{2}} exp\left(\frac{F_{ch} - F_p}{2 j_T} \right)$$

The formulae for the current sources are resulted in the majority carriers and calculated by the following expressions:

$$I_A = 8 m_n C_a \left(\frac{kT}{q L_з} \right)^2 \left[exp\left(\frac{q V_{AB}}{2kT} \right) - 1 \right];$$

$$I_B = 8 m_n C_a \left(\frac{kT}{q L_з} \right)^2 \left[exp\left(\frac{q V_{BC}}{2kT} \right) - 1 \right]$$

Where L_g – the gate length; V_{AB}, V_{BC} – potential differences between the points AB и BC.

The given electrical model DCLGJ can be used for modeling DCL elements circuits, analysis on the transition process in the devices on the DCLGJ and for other purposes [1].

REFERENCES

[1] N.Tsyrelchuk, I.Rusak., The devices with the Charge Connection Conducted by p-n transition. Foreign Electronic Technique, N 9, pp. 3 – 36, 2007.

[2] Tsyrelchuk N. Analogue-digital and digital-analogue transformers on the devices with the charge link, conducted by p-n transitions. – In book.: Perspectives of the development and application of the automated radiomeasuring apparatus in the national economy: theses of the report NTC, Minsk, – pp 7-10 , 2007.

[3] Kuznetsov J., Shilin V., Microschemotechnics on the devices with the charge connection. – M.: Radio and Communication, 160 p, 1998.